(12) EUROPEAN PATENT APPLICATION

(71) Applicant: ALCATEL STANDARD ELECTRICA,
S.A.
Ramirez de Prado, 5
ES-28045 Madrid (ES)

(72) Inventor: Martinez Garcia, Francisco
Carolina Coronado 37, 2. C
E-28017 Madrid (ES)
Inventor: Diaz Molina, Francisco
Victor Andrés Belaunde 51,
Portal B, 3. A
E-28016 Madrid (ES)

(74) Representative: Pohl, Herbert, Dipl.-Ing et al
Alcatel SEL AG
Patent- und Lizenzwesen
Postfach 30 09 29
D-70449 Stuttgart (DE)

(54) **Method and device for automatic synchronisation of data bursts.**

(57) Applicable to cordless communications systems with time division multiple access, TDMA, for synchronising the timebases of cordless terminals and base stations.

This device, which receives periodically and for a short interval of time a burst reception signal (A) to be synchronised, incorporates a register (1) which stores the value of a counter (3) when the burst reception signal (A) is high and subtracts from it, in an adder circuit (2), a reference value (REF) in order to adjust the references between the two timebases. To the output value (DELTA), a maximum value (MAX) is added or subtracted in a second adder circuit (4), depending on what timebare, the internal or the reference one is faster.

Its output is compared with that of the counter (3) in a comparator (5) and the output (T) from the comparator is applied to a control circuit (6) that determines the module in the counter (3) for lengthening or shortening the burst to achieve synchronism.
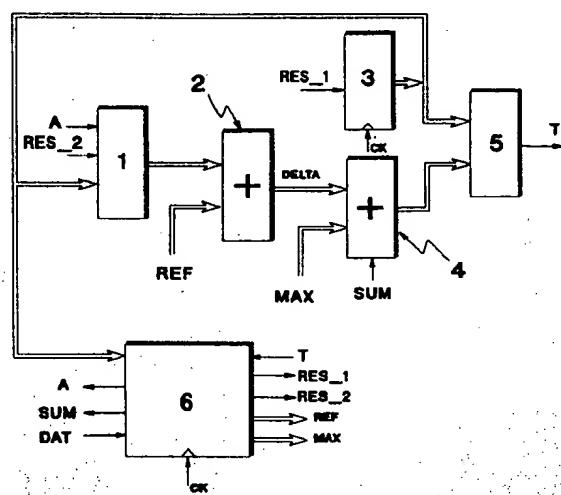
FIG. 3

OBJECT OF THE INVENTION

This invention concerns a device which, with an externally generated data burst signal, produces the automatic synchronisation of the timebase generated internally by a cordless terminal in order to permit communications with a base station by means of time division multiple access techniques.

This invention is of particular application in those cordless receivers which, with a minimum power consumption, have to lock on to the timebase generated in the base station with which they are communicating so that, in this way, they are in condition to send and receive bursts at any moment without losing them and without causing collisions with those coming from other terminals or from the base station itself.

BACKGROUND TO THE INVENTION

In many modern cordless communications systems use is made of time division multiple access techniques, TDMA, in which both the base station and the cordless terminal have to send and receive bursts of information in a perfectly defined time slot so that they are able to communicate with each other without loss of bursts and without interfering with other channels located in different time slots.

For this reason both parts must have a common timebase that makes this possible.

The manner in which this is normally achieved is that the base station generates a timebase, termed master timebase, while the cordless terminal has a timebase, termed slave timebase, that has to lock on to that of the base station. This locking is necessary because drifting between the two timebases occurs as a result of using different oscillators to generate them.

To produce the necessary synchronisation between the timebases of the base station and of the cordless terminal, the latter has to "listen" continuously the base station and to compensate progressively, also in a continuous manner, any small shifts that occur in its own timebase, so that when it has to receive or send a burst, the timebases of both parts are already synchronised and communication can take place between the two parts without problems resulting from a lack of burst synchronisation.

The fact that there are some periods of time during which the cordless terminal is not receiving bursts generated in the base station is not important if these are not long enough such that the drift between the two timebases when bursts from the base station are received once again, makes correct resynchronisation impossible.

It is therefore necessary for the cordless terminal to be permanently "listening" the base station,

resulting in an unnecessary current consumption that has a major impact on the duration of the terminal batteries. This is particularly important for the so-called pocket terminals, the batteries of which must have considerable autonomy.

This problem becomes especially significant when the terminal is used infrequently, and it can occur that the batteries become discharged after a certain number of hours even without the user having actively employed the terminal.

TECHNICAL PROBLEM TO BE OVERCOME

As a consequence of the state of the art described above, the technical problem to be overcome lies in maintaining synchronism between the timebases generated in the base station and in each of the cordless terminals in a wireless communications system, with a power consumption so low that it is possible to achieve a terminal autonomy of long duration.

CHARACTERISATION OF THE INVENTION

The device according to the invention compensates internal timebase drift in a cordless terminal with respect to an external reference. This internal timebase is generated by a counter that maintains a count of the bit considered by this timebase within each time slot that constitutes the frame and by a control circuit that carries out the control of the timebase in question.

This device is characterised in that it receives, in periodic form and for only a short interval of time, a burst reception signal with which it has to synchronise its own internal timebase.

In order to perform this process, the device includes a storage register that stores the output signal from the counter at the moment when the burst reception signal is received with an active level. It also incorporates a first adder which subtracts the content of the storage register from a reference value that indicates the bit, within each time slot, when the burst reception signal is active. The output of this adder, indicates the shift, expressed as a number of bits, between the external reference timebase and the internal timebase of the device.

It also has a second adder which, by means of a sum or a difference between a maximum value corresponding to the number of bits of the time slots and the output value of the first adder, obtains the value to be reached by the counter that forms part of the timebase so that, for the next burst, both timebases, the internal and the external reference, are synchronised.

The function is a sum or a difference, depending on whether the internal timebase was faster or

slower than the external reference timebase, this being detected by the control circuit, whereby, in some later time slot, its duration is increased or shortened in order to bring it into synchonisation with the external reference. For this, use is made of a comparator which compares the output from the second adder and that of the counter which forms part of the internal timebase. The output of this comparator is sent to the control circuit to inform it when the counter has reached the value of the second adder in order to proceed to initialise the counting process in the latter and thereby lengthening or shortening the normal count value for synchronising the internal timebase with the external reference generated in the corresponding base station.

For a low current consumption, this device permits to maintain synchronisation between the timebases in cordless terminals and base stations in systems with time division multiple access, TDMA, making communications between the two parts possible.

BRIEF FOOTNOTES TO THE FIGURES

Below a fuller explanation is given in the description of the invention, based on the figures attached in which:

- figure 1 shows a cordless communications system in which this invention is applied,
- figure 2 shows timing diagrams in which can be seen how synchronisation is acquired in the timebases produced by means of the invention, and
- figure 3 shows the block diagram of a data burst synchronisation device according to the invention.

DESCRIPTION OF A PREFERRED IMPLEMENTATION

This invention was specially developed for a cordless communications system as shown in figure 1 which makes use of time division multiple access, TDMA, techniques. In this system, base stations BS1, BS2 permit a set of cordless terminals T1, T2 to have access to a communications network.

Both parts, the base stations BS1, BS2 and the cordless terminals T1, T2 have to maintain a common timebase, at least for each assembly formed by a base station and its associated cordless terminals, so that each one knows when it has to prepare to receive information and when it has to transmit it without producing overlapping of bursts coming from different sources.

For this reason, all the equipments (each base station and each cordless terminal) generate a

timebase in such a way that the timebase generated by each base station is considered to be the master or reference, and the terminals associated with this station must be synchronised with it.

In simplified terms, the timebases are constituted by a cyclic counter 3 that counts the bits of each time slot, and a control circuit 6 that monitors which is the pertinent slot in the frame.

As has been mentioned when discussing the state of the art, the normal situation is that the cordless terminals are "listening" the base station continuously permitting them to keep their timebases locked on continuously, considering that in the half-frame during which the base stations are not transmitting (corresponding to the terminals), drifting is very slight and the terminals can immediately lock in once again.

This solution requires a constant power consumption from the batteries of the mobile terminals, even in the event that the terminal is never used to establish a communication. This is why in the terminals, in accordance with the invention, the receiver is kept off for the greater part of the time while the internal timebase of the corresponding cordless terminal runs freely and, consequently, because of inherent drift, the terminal timebase gradually shifts with respect to that of the base station to which it belongs, as can be seen from figure 2.

In this figure, frame 21 is equivalent to the timebase generated by the base station considered to be the master. Signal 22 corresponds to the burst reception signal A that is active in the bit following the reception of the burst header and, consequently, the active level is shifted by a certain number of bits with respect to the first bit.

Signals 23 and 25 respectively show the situations in which the internal timebase of the cordless terminals is faster or slower than the external reference produced by the base station.

Periodically, and in order to restrict the amount of drift, the receiver of the terminal in question comes on for a few moments, sufficient time to resynchronise its internal timebase with the base station timebase, by means of the device according to the invention.

For this, the control circuit 6 that receives the data signal coming from the receiver DAT generates a burst reception signal A, which has an active level when the burst header is detected in a time window that is sufficiently wide to allow for the maximum drifts produced from the last time that synchronisation took place. This burst reception signal is logically produced, at the earliest, in the last bit of the header of the bursts.

The burst synchronisation device, therefore, stores in a storage register 1 the value of the counter 3 of the timebase and subtracts it, in a first

adder 2, from a reference value REF which is the bit in which the burst reception signal A is generated. This first adder 2 produces an output DELTA that is the shift, expressed as a number of bits, between the two timebases, the internal one of the cordless terminal and the external reference coming from the base station.

It also has a second adder 4 that can perform the addition or subtraction, depending on an add control signal SUM, of a maximum value MAX which is the number of bits that comprises each complete burst and the output signal DELTA from the first adder 2. This add control signal SUM indicates addition in the internal timebase is delayed with respect to the external reference, or subtraction in the opposite case.

The output of the second adder 4 therefore indicates the number of bits that a burst must have to produce synchronisation. This information is sent to the control circuit 6 via the output T of a comparator 5 that compares this output of the second adder 4 with that of the counter 3.

The control circuit 6 also generates a first initialisation signal RES__1 that is applied to the counter 3 so that it reinitialises counting when a maximum value MAX is reached which is the value of the number of bits in each burst in the event that the internal timebase is already synchronised, or a different value indicated by the second adder in the event that synchronisation is in process. In this second case, the duration of the time slot is lengthened or shortened in order to obtain synchronisation as is indicated in figure 2 with the signals 24 and 26.

It also generates a second initialisation signal RES__2 that suppresses the content of the storage register 1 when the synchronisation process has already been completed.

Claims

1. **DEVICE FOR AUTOMATIC SYNCHRONISATION OF DATA BURSTS** to compensate drifting, with respect to an external reference, in a timebase generated by a counter (3) that continually indicates the bit number considered by this timebase within each time slot that constitutes the frame and a control circuit (6) for controlling it, and **characterised** in that it receives on a periodic basis and only during certain determined time windows, a burst reception signal (A) generated from the external reference with which its timebase must be synchronised.

2. **DEVICE** according to claim 1, **characterised** in that it comprises:

   - a storage register (1) that stores the value of the output signal of the counter (3) at the moment when it receives the burst reception signal (A),
   - a first adder (2) that subtracts the previous value in the storage register (1) from a reference value (REF) which indicates, in terms of a number of bits and for each time slot that constitutes the frame, the position that the burst reception signal occupies; this adder (2) producing an output signal (DELTA) that indicates, also as a number of bits, the shift between the timebase of the external reference and the internal timebase generated by the counter (3) and the control circuit (6),
   - a second adder (4) that performs the addition or the subtraction between a maximum value (MAX) corresponding to the total number of bits that constitutes each burst and the output signal (DELTA) of the first adder (2), depending on the enabling or desabling of a sum control signal (SUM) which is a function of whether the burst reception signal (A) has been received before or after the position it should occupy in the internal timebase, and
   - a comparator (5) that compares the outputs corresponding to the counter (3) and to the second adder (4), and which produces a comparison signal (T) that is applied to the control circuit (6) which initialises the counter (3) by means of a first initialisation signal (RES__1) that is received by the counter (3) for lengthening or shortening in this way the normal count value and synchronising both timebases.

3. **DEVICE** according to claim 2, **characterised** in that the burst reception signal (A) is generated in the control circuit (6) from the detection of the header, or part thereof, of the bursty data signal (DAT).

4. **DEVICE** according to claim 2, **characterised** in that the shortening or lengthening of the corresponding time slot takes place not in the count following but in a determined time slot reserved for this function in which no internal functions of the receiver are performed where the time slot duration may be critical.

5. **METHOD FOR AUTOMATIC SYNCHRONISATION DATA BURSTS** for compensating drift with respect to an extenal reference in an

internal timebase **characterised** in that it includes the stages of:

- obtaining a burst reception signal (A) through the detection of the burst header in a data signal (DAT) produced externally,
- measuring the difference in time, expressed as a number of bits, between the burst reception signal (A) and the instant when the internal timebase reaches a reference value (REF) that indicates the position that the last bit of the burst header occupies in it, and
- re-initialising the counter (3) when it reaches the value obtained in the preceding measurement so that the next burst is lengthened or shortened depending on the preceding measurement in order to synchronise the internal timebase, resulting in this difference in time being zero.

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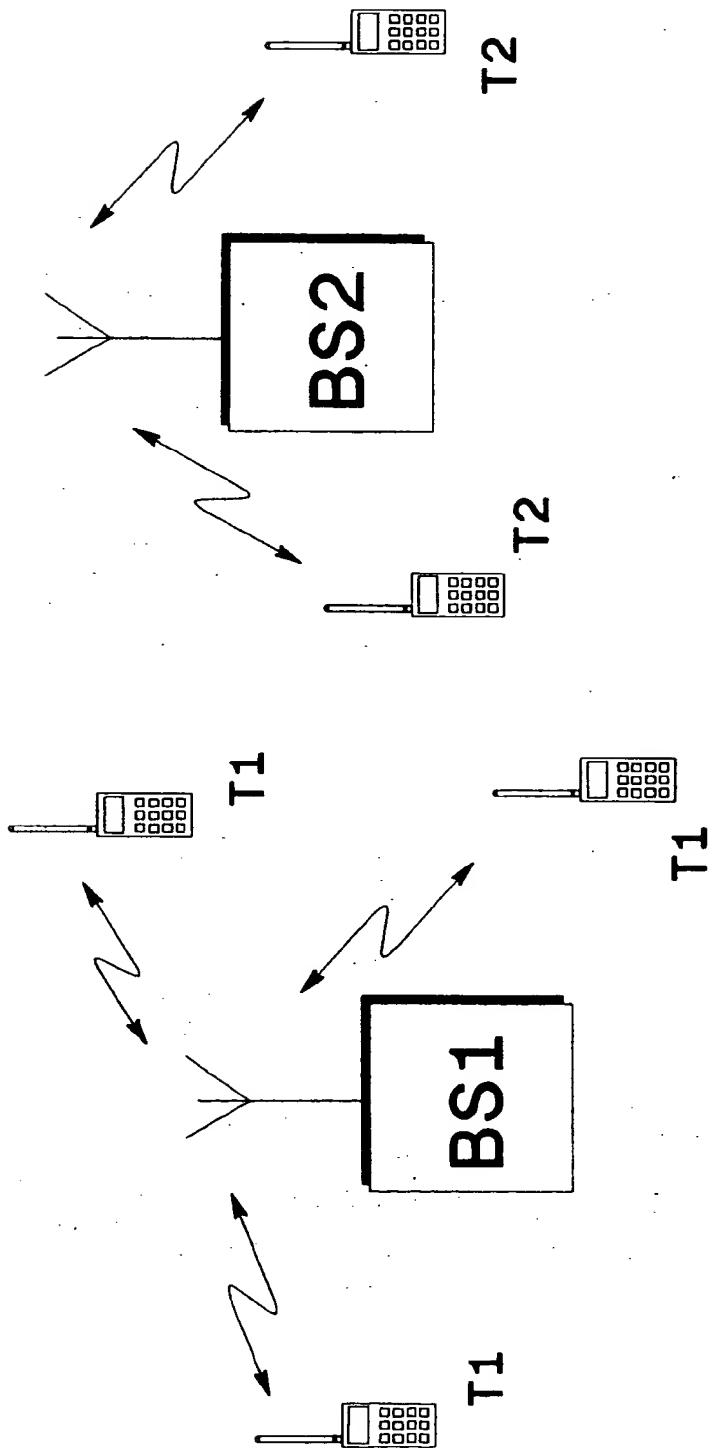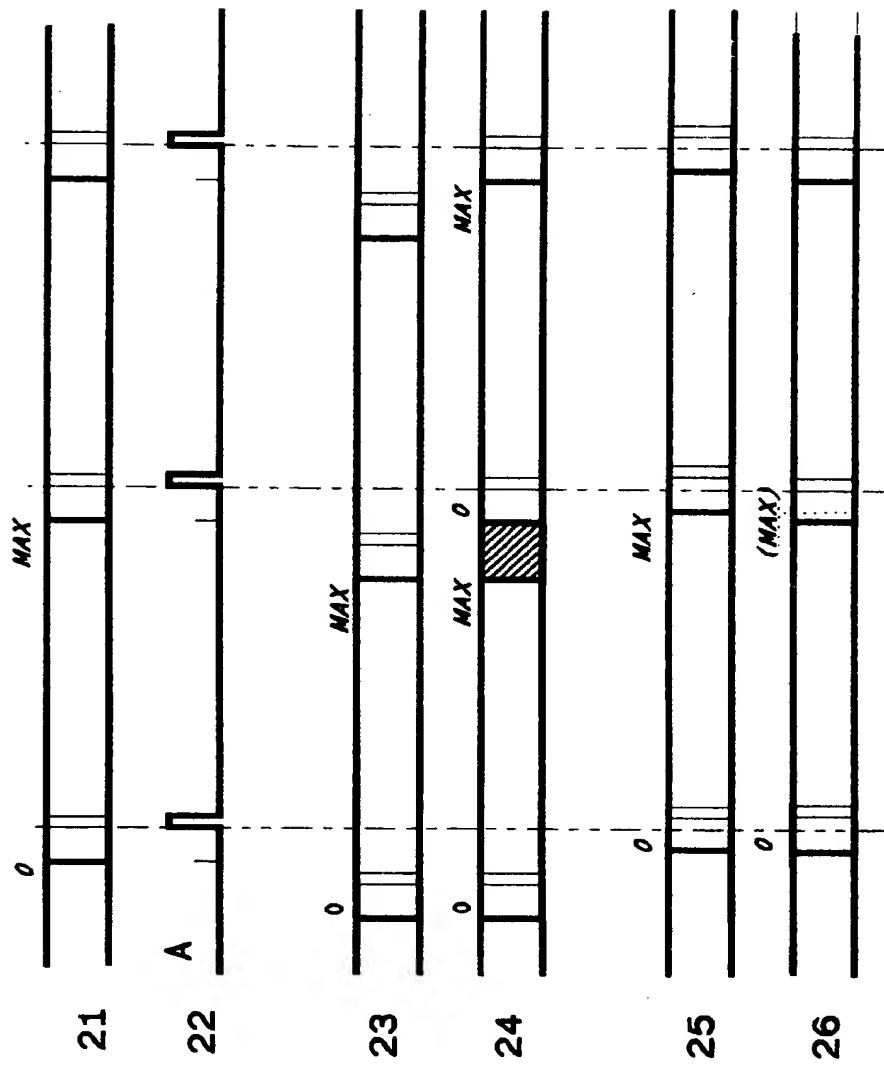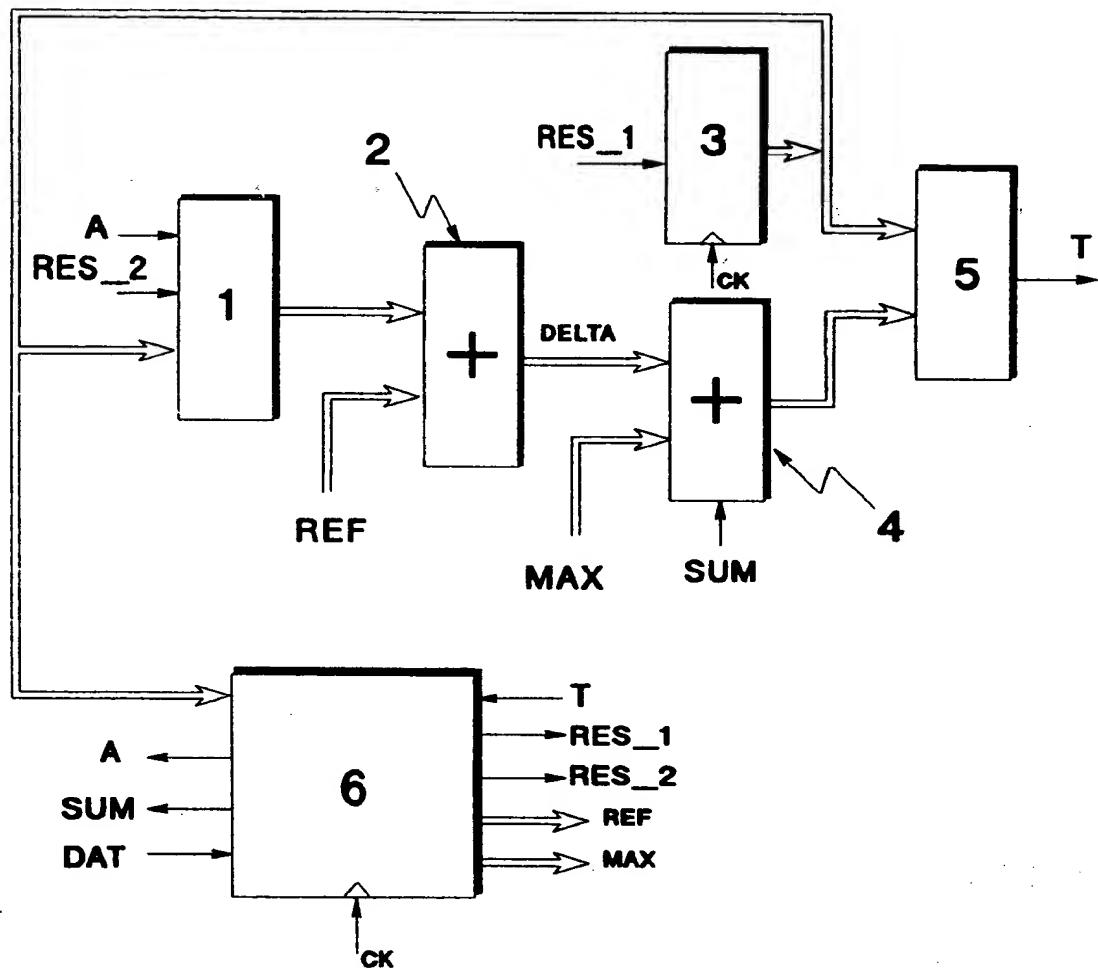
T2

BS2

T2

T1

T1

BS1

T1

T1

FIG. 1

FIG. 2

FIG. 3

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO-A-92 10884 (HEDDERLY) * page 3, line 33 - page 4, line 25; figure 2 * ---	1,5	H04B7/26
X	GB-A-2 254 226 (ERICSSON) * page 3, line 12 - line 30 * ---	1,5	
A	EP-A-0 511 614 (NEC) * claims; figure 2 * ---	2,3	
A	EP-A-0 474 138 (NOKIA MOBILE PHONES) * claims * ---	2,3	
A	EP-A-0 507 384 (PHILIPS) * claim 1 * -----	4	

TECHNICAL FIELDS
SEARCHED   (Int.Cl.6)

H04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 February 1995	Bischof, J-L

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